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GRAPS User's Guide

A Graphical Plotting System for
Displaying Scientific and
Engineering Data

James C. Logan
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INTRODUCTION

This document provides an introduction and update to the Graphical Plotting System (GRAPS), a plotting utility developed by the Naval Ocean Systems Center for the personal computer.* GRAPS provides a convenient, user-friendly tool for the display of engineering and scientific data in a number of conventional plot formats. Linear, semi-log, log-log, polar, Smith, and contour plot formats are among those that can be selected. User-friendly features include auto and user-defined scaling, text editing on graphics screens, and data file management options. Auto and user-defined scaling are new GRAPS features. The polar plots have been significantly improved and the contour plot added. The data file management options have also been expanded. GRAPS will plot any data stored in ASCII files in the GRAPS format.

GRAPS is intended to be used as a stand-alone utility for the preparation and display of engineering and scientific data. It is not suitable for inclusion as part of another program, although subroutines could be stripped out for inclusion in other programs. GRAPS is set up to read data from a disk file written (in ASCII) to a simple format. The disk file may be created by using an editor or word processor. Preferably, a subroutine may be included in the applications program to write the raw data directly to a disk file in the GRAPS format.

GRAPS provides a screen display of the plot, with options to select the plot format, adjust the scale range and scale tick marks, and create and edit the text labels on the plot. A visual display of the plot provides full freedom to compose an attractive and informative display of the data which is similar to the final hard copy. GRAPS sends HP plotter commands to the COM1 port. Hard copy can also be produced directly on a printer by using the shift-print screen keystroke.

This document is intended to be used as an introduction to the use of GRAPS as well as a reference to GRAPS options. The following section describes the hardware System Requirements for GRAPS. The next section, entitled Operation, provides an overall description of the use and configuration of GRAPS on a computer system with a hard disk. The section on Main Screen Options describes the purpose and use of each option in the order they appear on the main screen function menu. First-time users should have GRAPS running and before them as they read through this section. The section Contour Plots Screen Options describes the contour plot screen function menu. The section on Shell Commands describes how to use these special features to issue DOS commands from GRAPS. The section on SWITCH describes the use of the SWITCH utility program to swap the abscissa and ordinate data. The last section describes the GRAPS format for plot data files. Appendix A is intended as a quick reference guide for various GRAPS options. Appendix B summarizes the salient differences between the plot data file structures of the main GRAPS options and contour plots. Appendix C gives the plots obtained from the sample data files and the default GRAPS auto-scale.

*R.T. Laird. GRAPS: *Graphical Plotting System*, NOSC TD 820. Naval Ocean Systems Center, San Diego, California. July 1985.

SYSTEM REQUIREMENTS

The new GRAPS is written in BASIC for use on an IBM-compatible microcomputer. QuickBASIC is used to compile the program. The program will not run in the BASIC interpreter and it may not be compatible with other compilers without extensive modification.

GRAPS requires an IBM-compatible computer with at least 256 kilobytes main memory and CGA (color graphics adapter) graphics capability. A color monitor is optional since the plots are displayed in monochrome. A hard disk is also not required, but is highly recommended. For speed and convenience, GRAPS should be installed in a directory of its own on the hard disk. A math coprocessor is required. If the math chip is not available, the program must be recompiled.

GRAPS assumes an HP-compatible plotter on port COM1 to produce hard copy of the plots. An editor and compiler are required to change the source code to COM2. Only HP plotter commands are supported by GRAPS. Major code modification may be required to use other plotter command conventions.

Although the new GRAPS does not support printer screen dumps, most computer system packages include a screen-dump driver as part of the standard package. The shift-print-screen keystroke is generally sufficient to send the graphics screen to the printer. The screen dump is inherently slow, and the quality of the result is normally unacceptable for report purposes. The use of an HP-compatible plotting device is preferred.

The user is assumed to have a basic knowledge of DOS, especially in the areas of file-naming conventions and directory-subdirectory operations.

OPERATION

Both source and executable code are available for GRAPS. All the GRAPS files will fit on a single 1.2-megabyte floppy or on two 360-kilobyte floppy diskettes. The files will be arranged on two low-density floppies, as shown in Table 1.

The following discussions assume that GRAPS is installed on a hard disk in a directory named \GRAPS\ . You may create this directory yourself or use the LOAD.BAT batch file provided for your convenience. Please see your DOS reference manual for detailed instructions on creating directories and copying files. The minimum files that should be present in your \GRAPS\ directory are those found on diskette 1 listed in Table 1. If you choose a different arrangement, the discussions are still relevant, but you may have to interpret the discussions to fit your setup.

Unlike the original GRAPS, the new GRAPS cannot be run in interpreter BASIC. It may be loaded and executed by using the QuickBASIC (version 4.0) compiler. This is a convenient way to test GRAPS should you choose to customize GRAPS for your own use. However, to produce an executable file, GRAPS should be compiled and linked from the DOS command level by using the batch file GEXE.BAT and the QuickBASIC compiler. This step has been completed for your convenience. The resulting executable file, GRAPS.EXE, is found on the high-density diskette or on the low-density diskette 1. GRAPS.EXE requires a math coprocessor chip and uses COM1 for the plotter.

The executable copy of GRAPS is run from the DOS command level by entering the command "GRAPS." Alternatively, you may choose to set up a batch file that will conveniently execute GRAPS from any directory on your system. For example, the batch file G.BAT

Table 1. Arrangement of GRAPS files on two 360-kilobyte floppy diskettes.

Diskette 1		
GRAPS	EXE	The executable code for GRAPS consists of these three files.
GRAPSCON	EXE	As a minimum, all three must be present to run GRAPS.
BRUN40	EXE	
GRAPSDEF	SYS	This is the default system configuration file. It is read by GRAPS to initialize the program. It should be present at run time.
SWITCH	EXE	This is the executable code for the switch utility. SWITCH exchanges the abscissa and ordinate values in an ASCII data file.
BILIN	DAT	Nine sample data sets are included to illustrate the plot formats
CONTOUR	DAT	and data record formats.
LOGLOG	DAT	
LINEAR	DAT	
LOGLINH	DAT	
LOGLINV	DAT	
POLAR	DAT	
POLARCCW	DAT	
SMITH	DAT	
README	DOC	Additional general information provided to supplement this documentation.
USER	DOC	
CONTOUR	DOC	
LOAD	BAT	This batch file is provided as a convenient means to create the \GRAPS\ directory and load the contents of the disk.
G	BAT	
CD	CMD	This batch file with companion file are provided as a convenient means to run GRAPS. Both should be placed in the root directory.
Diskette 2		
GRAPS	BAS	The source code for GRAPS is contained in these four files.
GRAPSLIB	BAS	These are ASCII files written in compliance to the QuickBASIC 4.0 program level.
GRAPS	CMN	
GRAPSCON	BAS	
GRAPS	MAK	Used by QuickBASIC 4.0 when loading the source code for editing. Using the command "QB GRAPS" will load GRAPS.BAS and GRAPSLIB.BAS into QuickBASIC.
GEXE	BAT	This batch file is used to compile and link GRAPS from the DOS command level. Compiling from QuickBASIC will result in a "program memory overflow" error.
SWITCH	BAS	This is the source code for the switch utility. SWITCH exchanges the abscissa and ordinate values in an ASCII data file.

and its companion file, CD.CMD, may be available at the DOS command level from any directory, provided they are located in your root directory. Entering the DOS level command "G" from any directory will cause execution of GRAPS and return you to the directory from which you started when you exit GRAPS.

Data files for plotting may be resident in any directory or subdirectory on your system hard disk, RAM disk, or floppy diskette. Drive and directory designations may be appended to file names. Supplied names and extensions must comply with the file-naming conventions of DOS. It is suggested that the \GRAPS\ directory be used exclusively for the GRAPS-related programs and sample data sets. User data files should not be stored in the GRAPS directory.

A complete description and instructions for the use of GRAPS are given in the following paragraphs. Briefly, the sequence of steps for use of GRAPS is as follows: After initial installation, the first step in the use of GRAPS is to designate (via the F1 function key) the file name containing the data to be plotted. The data must be in the GRAPS format as described below. If the plot format type is not given in the first record of the plot data file, the second step is to select the plot format type (via the F2 function key). Now the plot may be viewed (function key F3), the scale adjusted (function key F5), the text labels edited (function key F6), and the results plotted (function key F4), in any order desirable.

MAIN SCREEN OPTIONS

The main screen provides a menu of function keys in a box and a status line across the bottom, as illustrated in Fig. 1. The function keys are used to select the various options as indicated and described below.

The status line has three fields of information. From left to right they are (1) the current plot data file name, (2) the current plot format type, and (3) the current GRAPS setup file name. The first two fields are initially blank; the last field normally displays the file name GRAPSDEF.SYS, the default GRAPS definition file. This field is empty only when GRAPSDEF.SYS is not in the same directory as GRAPS.EXE, the executable code.

Function Menu

F1 > set filename	F2 > set graph type
F3 > view graph	F4 > plot graph
F5 > change scale	F6 > edit labels
F7 > change setup	F8 > save setup
F9 > save file	F10-> exit program

| GRAPSDEF.SYS

Figure 1. GRAPS main screen. Initially, the status line will only display the default system file name, GRAPSDEF. SYS, in the third field.

The default setting is for a color monitor. If you have a monochrome system, the image may appear fuzzy or hard to read, in which case, you may want to skip ahead at this point to the description of the Change Setup Option (F7) and toggle the color to false.

SET FILE NAME (F1)

The first step is almost always to select function key F1 to set the file name of the plot data. Data files may have any legal name permitted by DOS. Disk drive and directory designators may be appropriately tacked onto the file name. Leaving off these designators will default to the current drive and directory in which GRAPS resides. Please see your DOS reference manual for further information on naming files and designating directories and disk drives.

For demonstration, nine sample plot files are listed in Table I. Please use any one of the files in the list except CONTOUR.DAT, since selection of this file will dramatically change the sequence of events. Please see the section Contour Plots Screen Options below for more details. LINEAR.DAT is a good first choice for starting out. You may use the sample plot files to explore how various options work and examine the various plot types.

After pressing F1, enter the name of the GRAPS data file in response to the query. The file name may include any DOS legal extension. If you leave the file extension off, the default is DAT. After the file name is entered, it will appear in the first (lower left) field on the status line. This field will remain blank or display the file name previously designated if the file name you specify cannot be found.

GRAPS data files may now have a header record containing the graph format type. When this header is present, as in the sample plot files shown in Appendix C, it is unnecessary to set the graph type (F2). For the sample data set LINEAR.DAT, the graph type is LINEAR. The center field of the status line will automatically display this information. If the header is missing from the data file, the center status field will be blank or remain set at the previously set graph type. It is then necessary to select the graph type (F2) before proceeding with other options.

SET GRAPH TYPE (F2)

The second step in the use of GRAPS is generally to select function key F2 to set the graph type, although this option may be selected before the file name is designated (i.e., before F1 is selected). Selecting F2 will be necessary when the graph type is not designated by the first record in the data file to be plotted.

The sample files contain the plot format type specification in the first record, so this step is unnecessary when selecting one of these files. For example, when F1 is used to designate the data set LINEAR.DAT, the center field of the status line will automatically display the plot type LINEAR in the center field. If the header is missing from the data file, the center status field will be blank or remain set at the previously set graph type.

Pressing the F2 function key will add a box to the screen that lists the various plot format types, as illustrated in Fig. 2. The LINEAR plot type will be highlighted. Use the arrow keys on your numeric keypad to choose the graph type. You may change the graph type without changing the data file and thus look at the same data in linear, log, and polar formats. Press the function key F10 when your selection is made. The menu box of plot types will disappear, and the plot type will appear in the center field of the status line. Choosing CONTOUR will cause program GRAPSCON to be loaded.

Function Menu

F1 > set filename	F2 > set graph type
F3 > view graph	F4 > plot graph
F5 -> change scale	F6 > edit labels
F7 > change setup	F8 > save setup
F9 > save file	F10-> exit program

LINEAR	LOGLOG	POLAR
BILINEAR	LOGLIN-V	POLARCCW
CONTOUR	LOGLIN-H	SMITH

LINEAR.DAT | LINEAR | GRAPSDEF.SYS

Figure 2. GRAPS main screen after option F2 is selected. The status line shows that the file LINEAR.DAT has been loaded and that the plot format type is set for a linear plot.

If you are following this narrative for the first time and you have selected file LINEAR.DAT, then please select LINEAR for the plot type. You may return later to see the effects of switching to other plot types.

VIEW GRAPH (F3)

Selecting function key F3 displays the current file data plotted in the current graph type on the screen. The scale will be either for the scale specified in the file or for the values selected when option F5 is used. If neither the file name nor the plot format type has been selected, there will be no response, and the screen will continue to display the function menu. If an error in the data file is detected, an appropriate error message will flash on the screen. Press F10 to return to the menu screen.

Generally, you will select F3 to inspect the plot of a file selected or to examine the effects on the plot of changing the scale (F5).

PLOT GRAPH (F4)

Selecting function key F4 will send HP plotter commands to port COM1. This option will plot the current file and graph type on an HP-compatible plotter. The result will look similar to the plot displayed on the screen (by using F3 or F6). When you select F4, there will be a pause and a reminder to check that the plotter is ready to begin the plot. The plot may be aborted by using the escape key.

CHANGE SCALE (F5)

Function key F5 provides the means to change the origin and end values of the scales as well as the value spacing and the number of ticks per value of a plot. Some restrictions apply for certain graph types; i.e., Polar, Smith, and log scales. GRAPS does not permit changes to restricted fields. In the case of the Smith chart, no changes in scale are permitted; hence, pressing F5 when the Smith plot type is current results in no response.

When F5 is selected, a box will be displayed on the screen, with the parameters and fields that may be changed. Figures 3 through 8 illustrate the appearance of this box for various sample data sets. The arrow keys are used to select the field to be changed. The new value may then be typed in, followed by the return (or enter key). The selected fields are highlighted. In most cases, you may enter the desired value. In the case of POLAR and POLARCCW plot types, the End Value for degrees is a toggle. Pressing the return or enter key will toggle through 90, 180, and 360 degrees (see Fig. 7). Press F10 when done with all changes. Then use F3 or F6 to see the results.

GRAPH INFO:	X-Axis	Y-Axis
Scales	Linear	Linear
Origin Value	0	0
End Value	1500	50
Value Spacing	300	10
# Ticks/Value	2	2

Figure 3. Box displayed with the parameters and fields for sample plot file LINEAR.DAT when F5 is first selected.

GRAPH INFO:	X-Axis	Y-Axis	Y'-Axis
Scales	Linear	Linear	Linear
Origin.Value	0	0	0
End Value	1500	50	15
Value Spacing	300	10	3
# Ticks/Value	2	2	2

Figure 4. Box displayed with the parameters and fields for sample plot file BILINEAR.DAT when F5 is first selected.

GRAPH INFO:	X-Axis	Y-Axis
Scales	Log	Log
Origin Value	10^{-5}	10^{-18}
End Value	10^0	10^0

Figure 5. Box displayed with the parameters and fields for sample plot file LOGLOG.DAT when F5 is first selected.

GRAPH INFO:	X-Axis	Y-Axis
Scales	Log	Linear
Origin Value	10^4	500
End Value	10^8	1500
Value Spacing		200
# Ticks/Value		2

Figure 6. Box displayed with the parameters and fields for sample plot file LOGLINH.DAT or LOGLINV.DAT when F5 is first selected.

GRAPH INFO:	Degrees	Radius
Scales	Linear	Linear
Origin Value	0	-40
End Value	360	10
Value Spacing	90	10
# Ticks/Value	3	2

Figure 7. Box displayed with the parameters and fields for sample plot file POLAR.DAT when F5 is first selected. The display is the same for both POLAR and POLARCCW plot types.

GRAPH INFO:	X-Axis	Y-Axis	Contour
Scales	Linear	Linear	Linear
Origin Value	60.5	11.5	0
End Value	66.5	15.5	.04
Value Spacing	1.2	.8	.01
# Ticks/Value	2	2	2

Figure 8. Box displayed with the parameters and fields for sample plot file CONTOUR.DAT when F5 is first selected.

EDIT LABELS (F6)

Function key F6 produces a plot on the screen similar to that produced by function key F3, except for the addition of a menu line at the bottom of the screen. If neither the file name nor the plot format type has been selected, there will be no response and the screen will continue to display the function menu. If an error in the data file is detected, an appropriate error message will flash on the screen. When F6 is selected, the current data file is plotted in the current graph type on the screen. The scale will be either that specified in the file or that resulting from the values selected using option F5. A menu line will be superimposed over the last line (lowest line) of the plot. The menu line, shown in Fig. 9, defines the function keys that may be used to create and edit the labels on the plot.

F1 PICK F2 MOVE F3 INSERT F4 DELETE F5 TOGGLE F9 SAVE F10 EXIT

Figure 9. Menu line at the bottom of the screen for edit option (F6).

Use the arrow keys to position the cursor. Then select one of the function keys to exercise an edit option. The edit options are described as follows:

F1 PICK and F2 MOVE are used to move existing labels to new locations. F1 PICK is used to select an existing label, and F2 MOVE is used to accomplish the move. First, use the arrow keys to position the cursor at the beginning of the label to be moved. The cursor must be on the first character of the label. Then press F1. A beep will be sounded to indicate that the label has been found. Next, use the arrows to move the cursor to the new location desired. The label will not move until F2 is pressed. Another beep will be sounded when F2 is pressed to signal successful completion of the move. The label is erased from its original location and will appear in the new location.

F3 INSERT is used to create labels. First, use the arrows to locate the cursor at the starting point for the label, then press F3. There will be an immediate beep and the cursor will disappear. Anything typed from the keyboard will be displayed on the screen as you create the label. Upper and lower case numbers and symbols are allowed. A return will end the insert mode, causing a beep, and the cursor will appear at the beginning of the label just created. F1 and F2 can now be used for final positioning, e.g., centering.

F4 DELETE is used to erase a label. First, use the arrows to position the cursor at the beginning of the label to be removed. The cursor must be on the first character of the label. When F4 is pressed, there will be a beep and the label will be removed. Part of the plot may also disappear because the label was written over the top of the plot. To correct this, simply use F10 to exit, then return to edit with F6.

The menu line may cover up the label at the very bottom of the plot. F5 TOGGLE will toggle the menu line on and off, so you may inspect or edit this line of your plot.

F9 SAVE will save the plot with labels in a disk file. The new file has the same name as the one you started with but with an EDT extension. If the original file ended with DAT or any other extension except EDT, then the original data file is preserved intact.

F10 EXIT will return to the main menu. Any editing is preserved in memory, so you may see your results by using F3 or F6, or you may plot your results by using F4. Use F9 from either edit or the main menu to save the results to disk.

CHANGE SETUP (F7)

Function key F7 from the main menu provides the way to modify the GRAPS setup parameters. After pressing F7, enter the name of the setup file you wish to change. You may have as many setup files as may be convenient. The setup default file is GRAPSDEF.SYS, usually displayed in the lower-right field of the status line. Enter the name of the setup file you wish to change. Pressing only the enter or return key selects the current setup for change. The changes are not permanent, but are only good for the current GRAPS session. Use F8 to save the new setup in a convenient file for later reuse.

After a setup file is selected, a box will appear on the screen containing the various fields and parameters that may be changed. Figure 10 is an illustration of this box for the default file GRAPSDEF.SYS. The cursor will indicate the field to be changed. Use the down arrow to select the field you want to change and then press F1 to change it.

Color	:	TRUE	Data file ext	:	DAT
Plotter	:	HP7470A	Setup file ext	:	SYS
Number of pens	:	2	Status line	:	ON
Plotter speed	:	FAST	Shell commands	:	TRUE

Figure 10. Box displayed for option F7 (change setup) and setup file GRAPSDEF.SYS.

The fields Color, Plotter speed, Status line, and Shell commands are toggles activated via the F1 key. Pressing F1 for the other fields will produce a query for the new value. Answering this query with a return for the Plotter field will produce a response of NONE for the new value. This is useful to prevent locking up the computer when no plotter is available. For all other fields, no change will occur when the query is answered with only a return. The plotter speed may be toggled to SLOW for use in making transparencies or extending the life of old pens. The Shell commands may be toggled to FALSE to reduce the amount of buffered memory reserved by GRAPS for shell (or child) processes.

SAVE SETUP (F8)

Function key F8 is used to save the setup parameters for later use. The F7 option makes no permanent changes to the setup file. Changes made under F7 remain active only for the current GRAPS session. F8 must be used to save desirable setup parameters in a disk file, which can be later reloaded by using F7.

SAVE FILE (F9)

Function key F9 from the main menu is used to save the graph to a disk file. The current scale and graph type are also written to the file, along with any labels added or edited. At the query, any DOS valid filename and extension may be used to designate the plot data file. The path designators may also be tacked onto the file name.

Note that this option allows the use of any name and extension, while the save option under edit (F6) automatically uses the current file name (and path) and changes the extension to the default setting (EDT).

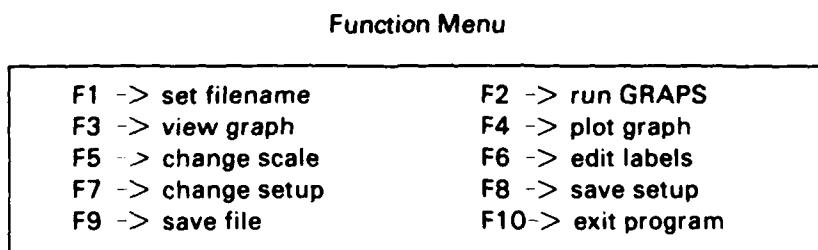
EXIT PROGRAM (F10)

The F10 key will end the GRAPS session. Pressing F10 produces the query 'Are you sure <YES>?'. Simply pressing return or entering YES or yes will terminate the GRAPS run and return you to the DOS command level. Any other response will continue with GRAPS execution.

CONTOUR PLOT SCREEN OPTIONS

The GRAPS Contour Plot Program, GRAPSCON, is a separate, stand-alone program; however, GRAPS, and GRAPSCON perform as a single unit. GRAPSCON may be executed from the main function menu of GRAPS, and similarly, GRAPS may be executed from the main function menu of GRAPSCON. Additionally, the function menus and options of GRAPS and GRAPSCON are similar.

Although GRAPSCON can be executed directly from the DOS command level, the natural way is to run GRAPS first. From the GRAPS main function menu, there are two ways to start up GRAPSCON. The usual way is to set the graph type (via F2) to CONTOUR. The second way is to select a plot file (such as the sample file CONTOUR.DAT) which has a header record for the contour plot type. In either case, GRAPSCON will be loaded into memory and executed. The main function menu of GRAPSCON is immediately displayed, as illustrated in Fig. 11.



| CONTOUR | GRAPSDEF.SYS

Figure 11. GRAPSCON main screen. Initially, the status line will display the CONTOUR graph type in the center field and the default system file name, GRAPSDEF.SYS, in the third field.

When GRAPSCON is executed by setting the graph type to CONTOUR from GRAPS (via F2), then the status line will display the CONTOUR graph type in the center field and the default system file name, GRAPSDEF.SYS, in the third field. This is also the case if GRAPSCON is executed directly from the DOS command level. When GRAPSCON is executed from GRAPS by selecting a plot file name (F1) and the file selected has the contour header record, the file name will appear in the first field of the status line.

In general, options on the function menu of GRAPSCON work exactly the same as GRAPS. Only the CONTOUR graph type is directly available. To use one of the other GRAPS graph types, select F2 to run the GRAPS program. Note that the record format for contour data file plots is incompatible with that of other graph types. You may not plot contour data as other plot types without changing the record format by using an editor.

SHELL COMMANDS

There are a few "hidden" capabilities of GRAPS in addition to the functions already presented. Three control characters act as DOS commands to provide useful DOS-level inquiries. These commands are called "shell" commands and the functions they perform are called "child" processes. To invoke these commands, hold down the control key, <CTRL>, while pressing the indicated key. Shell commands may be used anytime from the main function menu of GRAPS and GRAPSCON. Most <CTRL> shell commands also recognize "*" as a wild card.

DIRECTORY (<CTRL>-D)

This command produces a directory listing. The screen is cleared and the prompt "Directory to list <LOGGED>?" appears. Enter the path and directory to list or a return for the current directory. For example, a valid response giving the path and directory is "\DATA." The use of a wild card may select certain file types, e.g., "\DATA*.DAT."

CHANGE LOGGED DIRECTORY (<CTRL>-L)

This command changes the currently "logged" directory. The default is the directory in which the GRAPS program resides. Unless path information is attached to file names, GRAPS will always use the default or logged directory to search for or save files. <CTRL>-L will first clear the screen, and then the prompt "Change logged directory to <LOGGED>?" will appear. Any valid path and directory name will be accepted. A return will display the current logged directory and path. A valid response giving the path and directory is "\DATA."

SUSPEND PROGRAM (<CTRL>-S)

This command will temporarily suspend the GRAPS program for DOS-level operations. To return to GRAPS from DOS, enter the DOS command "EXIT."

TYPE A FILE (<CTRL>-T)

This command is simply the DOS type command in disguise. The screen is cleared and the prompt "File to type <NONE>?" appears. Enter the file name, complete with extension, or return to abort.

SWITCH

SWITCH is a BASIC program used to reorder pairs of numbers in a GRAPS format plot data file. SWITCH will reverse the order of the abscissa and ordinate data. This procedure is particularly useful during the process of deciding how best to display data. SWITCH is an auxiliary stand-alone program that may not be directly executed from GRAPS. SWITCH must be run from the DOS command level. Either use the <CTRL>-S shell command or F10 to exit to the DOS level.

The first question to answer is the file name on which SWITCH will operate. After a valid file name is supplied, a menu of three items will appear:

- 1 - ONE ORDINATE SCALE
- 2 - TWO ORDINATE SCALES
- 3 - POLAR OR SMITH CHART

Choose one option by number that corresponds to the data type in the file you have selected. Next, the same menu of three items will appear again. This time select the option corresponding to the plot type you expect to use for the results (usually the same as the original data).

Now SWITCH will determine and display the maximum and minimum values for the new ordinate and abscissa data. These values will be used for the initial scale choices by GRAPS. You will next be given the option to change the abscissa and ordinate values. The next question is the name of the file to store the modified data. It is best to use a new file name.

The last question is "CONTINUE (Y/N)?". Answering Y for yes will restart the SWITCH program. Answering N for no will exit the program.

PLOT FILE FORMATS

Perhaps the easiest way to understand the GRAPS plot file format scheme is to examine the sample data files supplied with the GRAPS software. However, some may prefer a written description, which follows.

Data files for GRAPS have four parts that must occur in order; they are (1) the header, (2) the scale, (3) the data, and (4) the labels. Figure 12 illustrates the required format. Please refer to this figure for the remainder of the discussion.

Header:	GRAPS LINEAR			
Scale:	0	1500	0	50
Data:	40	1.14		
	160	3.907		
	320	7.285		
	1280	17.702		
	1.234	-1.234		
	40	1.353		
	80	2.513		
	320	8.962		
	640	17.903		
	1280	28.797		
	-1.234			
Labels:	3	14		
	EFFICIENCY VS. RADIAL LENGTH (FT)			
	4	14		
(EFFICIENCY BASED ON AVERAGE GAIN)				
	5	13		
1 KFT TOP LOADED MONOPOLE AT 25 KHZ				
	6	16		
12 TOP HAT RADIALS; H'/H = .6				
	7	17		
BURIED RADIAL GROUND SYSTEM				
	8	21		
RADIALS BURIED 1 FT.				

Figure 12. File format for GRAPS data.

The header is an optional one-line (or one-record) entry that identifies the plot type to GRAPS. If this line is missing, GRAPS will not automatically set the graph type, but it will still read and plot the data. The header record must contain the word "GRAPS" in positions 1-5 and the graph type (in capital letters) starting in position 7. Whenever data are saved from GRAPS, the header line is automatically created by GRAPS. There is no need to place this line in your raw data, since GRAPS will read and plot your data if they are missing.

The scale is a one-line entry containing from 4 to 6 data items. The scale line is not optional. It must be present in each plot file as the first or second line, except for Smith chart plots. There is no scale adjustment of Smith charts, hence this line must not exist in Smith chart data files. The data items may be separated by spaces or commas. When data are saved from GRAPS, all data entries will be separated by commas.

Graph types LINEAR, LOGLIN-V, LOGLIN-H, and LOGLOG require four entries on the scale line; they are X1, X2, Y1, and Y2, where X1 and X2 define the abscissa scale end values and Y1 and Y2 defines the ordinate scale end values. For the log plots, the logarithmic data must be in powers of 10. Graph type BILIN requires six entries on the scale line. For BILIN (i.e., for a linear plot with two ordinate scales), the first four entries are the same as

LINEAR. The last two entries define the scale for the second ordinate, or right-hand scale, i.e., the scale line has entries X1, X2, Y1, Y2, Y1',Y2', where Y1 and Y2 are the scale ends for the left-hand ordinate axis and Y1'and Y2' are the scale ends for the right-hand ordinate axis.

Graph type CONTOUR also requires six entries on the scale line. The record contains the min/max values of the x, y, and z coordinates (xmin, xmax, ymin, ymax, zmin, zmax). The contours of the z values will be drawn.

The data to be plotted follow the scale data record. Each record or line of data appears as pairs of numbers separated by spaces or commas, except for contour plot data, which consist of sets of three numbers. (Contours are drawn for the third field based on the x-y location given by the first two numbers.) Data for any number of curves may be included in one plot file, except for contour plots (see Appendix B for further details). Each curve is separated by the flag 1.234, -1.234. The last curve in the file must end with the flag -1.234, -1.234, except for contour plots which end with -1.234, -1.234, -1.234.

The labels for the plots follow the plot data. Preceding each label line is an integer pair that defines the label location in the GRAPS label coordinate system. Labels are optional and are generally added by use of GRAPS.

Appendix A

GRAPS QUICK-REFERENCE USER'S GUIDE

F1 - SET FILE NAME

Enter name of GRAPS data file. Default extension is DAT, although any extension may be entered. GRAPS data files may now have a header record containing GRAPS in positions 1-5 and the graph type (in capital letters) starting in position 7. This header makes it unnecessary to set the graph type (see F2). See CONTOUR.DOC for more information on contour plots.

F2 - SET GRAPH TYPE

Use arrow keys on numeric keypad to choose the graph type. You may now change the graph type without changing the data file and thus look at the same data in linear, log, and polar formats. Press F10 when selection is made. Make sure the NumLock key is not depressed. Choosing CONTOUR will cause program GRAPSCON to be loaded.

F3 - VIEW GRAPH

Press function key F3 to display on the screen the current file data plotted in the current graph type for the current scale settings. Press F10 to return to menu.

F4 - PLOT GRAPH

Press function key F4 to plot current file and graph type on an HP-compatible plotter connected to COM1.

F5 - CHANGE SCALE

You may change the origin and end values, the value spacing, and the number of ticks per value. Some restrictions apply for certain graph types, especially Polar, Smith, and log scales. F5 has no effect for the Smith plot type. Select the field you wish to change with the arrow keys, then type in the new value followed by <Return>. Press F10 when done with all changes.

Note: The old F5 function, Print Graph, is now accomplished with the <PrtSc> key. As before, a suitable printer interrupt routine (e.g., GRAPHICS) must be installed.

F6 - EDIT LABELS

Use the arrow keys to position the cursor. Then:

- F1 - Pick a label to reposition. Cursor must be on the first character of the label.
- F2 - Move a "picked" label to the cursor position.
- F3 - Enter a new label at the cursor position and press <Return>.
- F4 - Delete the label at the cursor.
- F5 - Toggle the menu line. Allows viewing of and access to the bottom line of the screen.
- F9 - Save the graph with extension EDT.
- F10 - Return to main menu.

F7 - CHANGE SETUP

Enter the name of the setup file you wish to change. Pressing only <Return> allows you to change the current setup. Use the down arrow to select the field you want to change and then press F1 to change it.

Note: The old "Printer" field has been replaced by "Plotter speed," which can be toggled between FAST and SLOW. Use SLOW for transparencies or old pens. Press F10 to return to the main menu.

F8 - SAVE SETUP

Save the setup to a user-specified file. Use the F7 option to retrieve the setup later on.

F9 - SAVE FILE

Save the graph to a file. The current scale and graph type are also written to the file along with any labels added or edited.

F10 - EXIT PROGRAM

Terminates the GRAPS session.

Appendix B

GRAPS CONTOUR PLOTS

The GRAPS Contour Plot Program, GRAPSCON, was written as a program separate from GRAPS because GRAPS was getting too large and because the data and algorithms used are very different from those used by GRAPS.

In general, the program works exactly the same as GRAPS, with the following exceptions:

1. Data file differences.

The data file format for contour plots is somewhat different than other GRAPS data files. The essential features are:

A GRAPS header record is required. The first 13 characters of the first record must be "GRAPS CONTOUR." A space and comments may be added to this record. The second record contains the min/max values of the x, y, and z coordinates (xmin, xmax, ymin, ymax, zmin, zmax). The contours of the z values will be drawn. All following data records contain the x, y, z coordinates of the data points. These values may be separated by commas or spaces. The program assumes that the points are in logical order — the x's cycling as the y values change or the y's cycling as the x values change. The x/y values may be increasing or decreasing and do not need to be evenly spaced. The z value of any missing point will default to 0 or cause a run-time error.

The final data point must be -1.234, -1.234, -1.234. Text labels follow the data points as usual.

2. Graph Type.

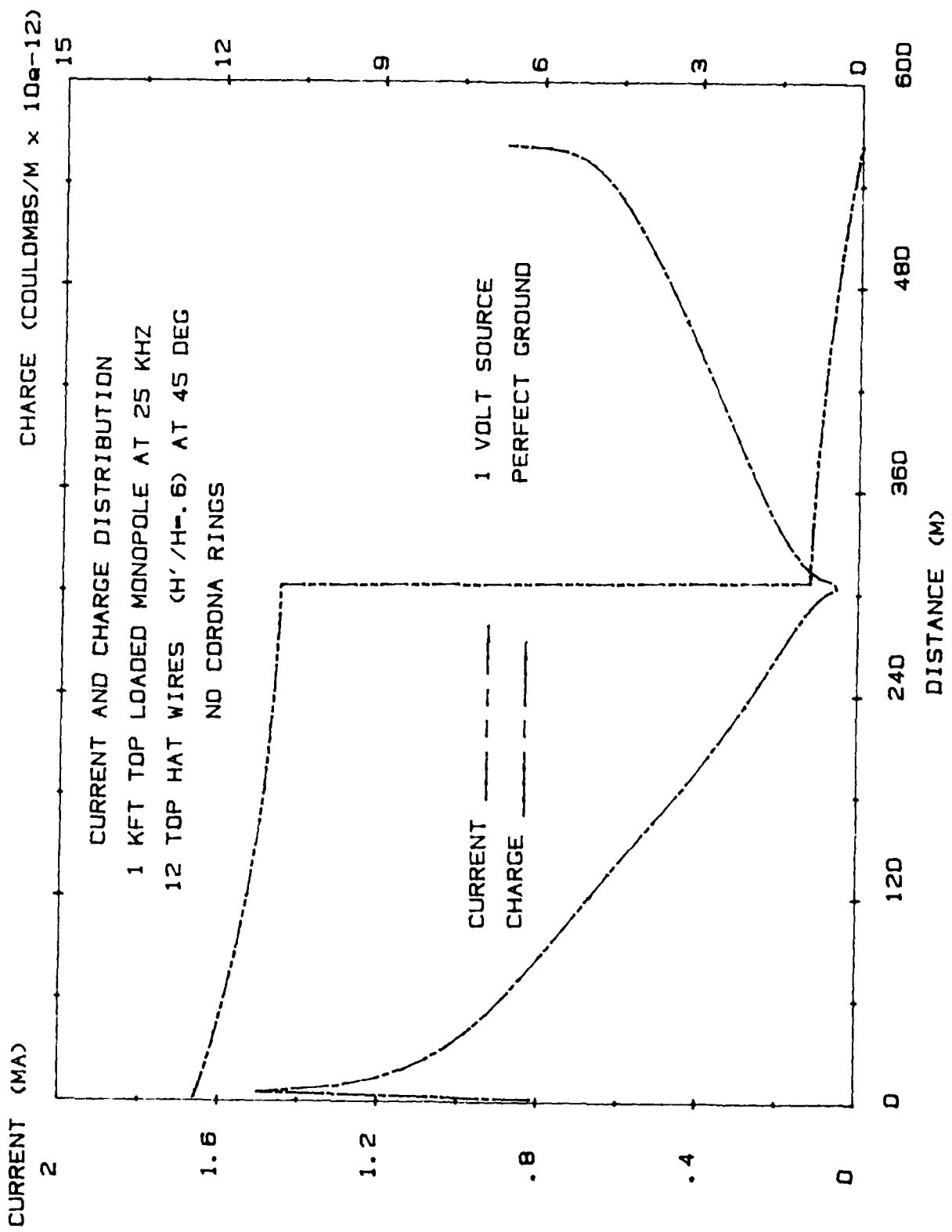
Only CONTOUR graph type is available. To use one of the other GRAPS graph types, you press F2 to run the regular GRAPS program.

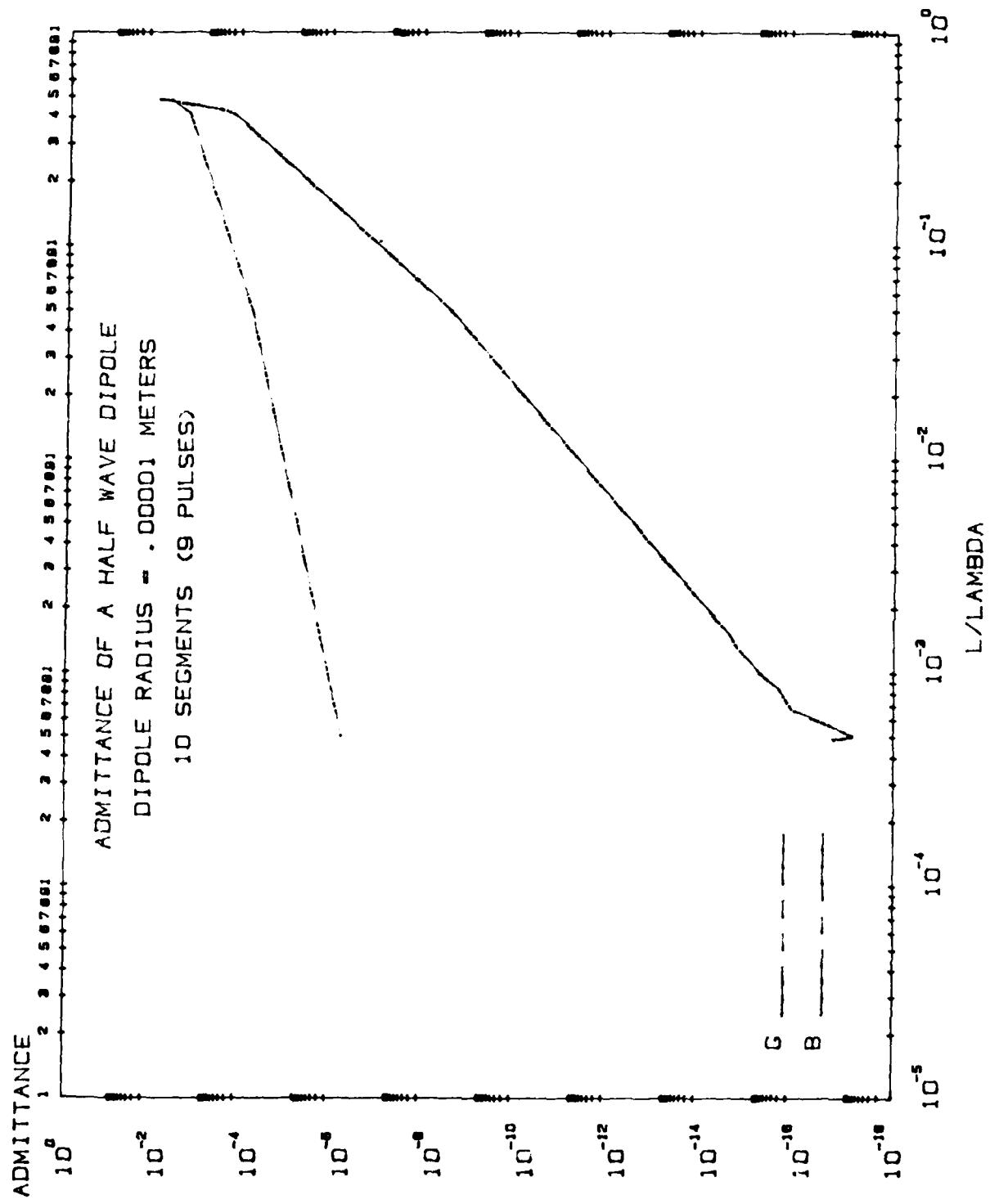
Appendix C

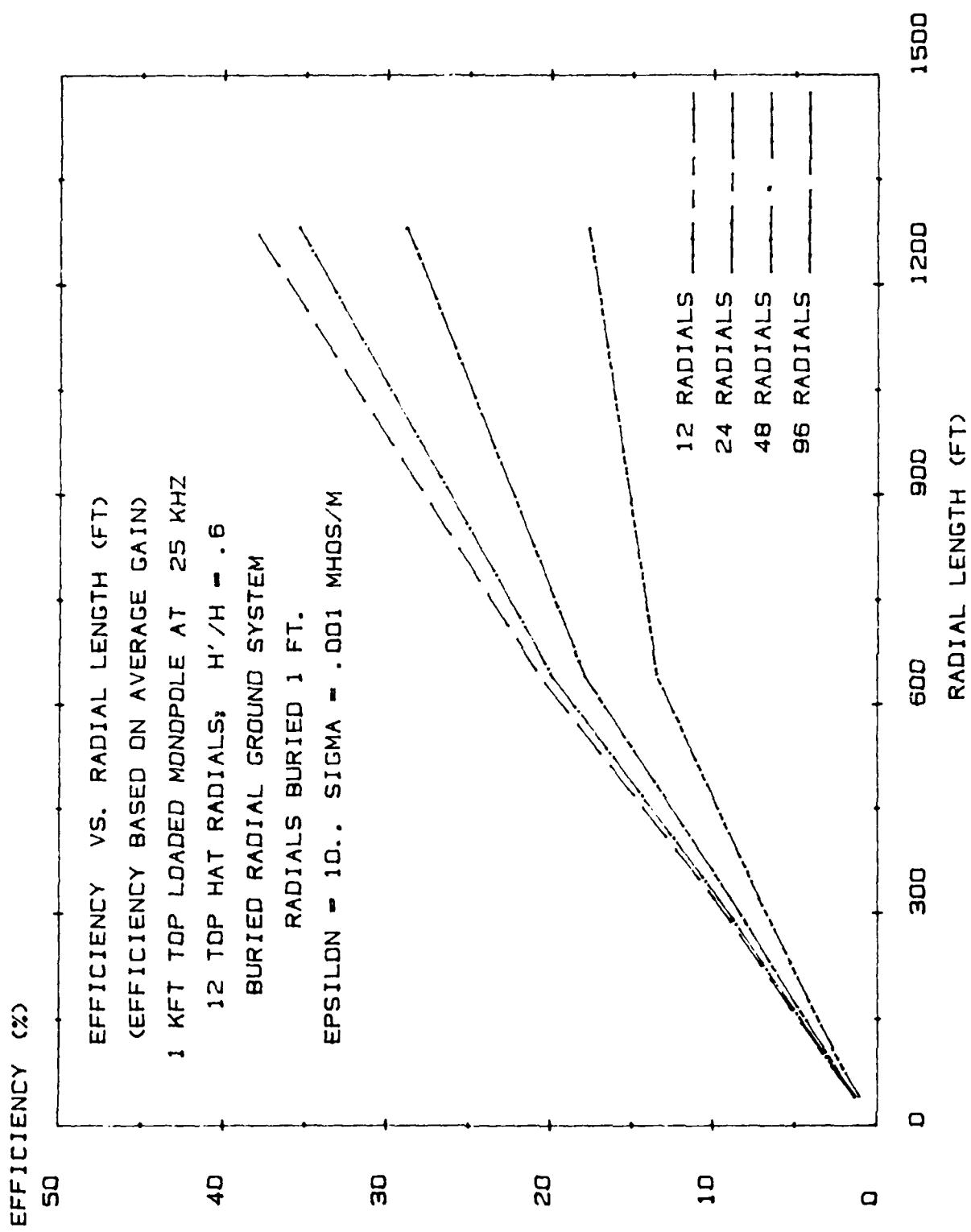
SAMPLE PLOTS

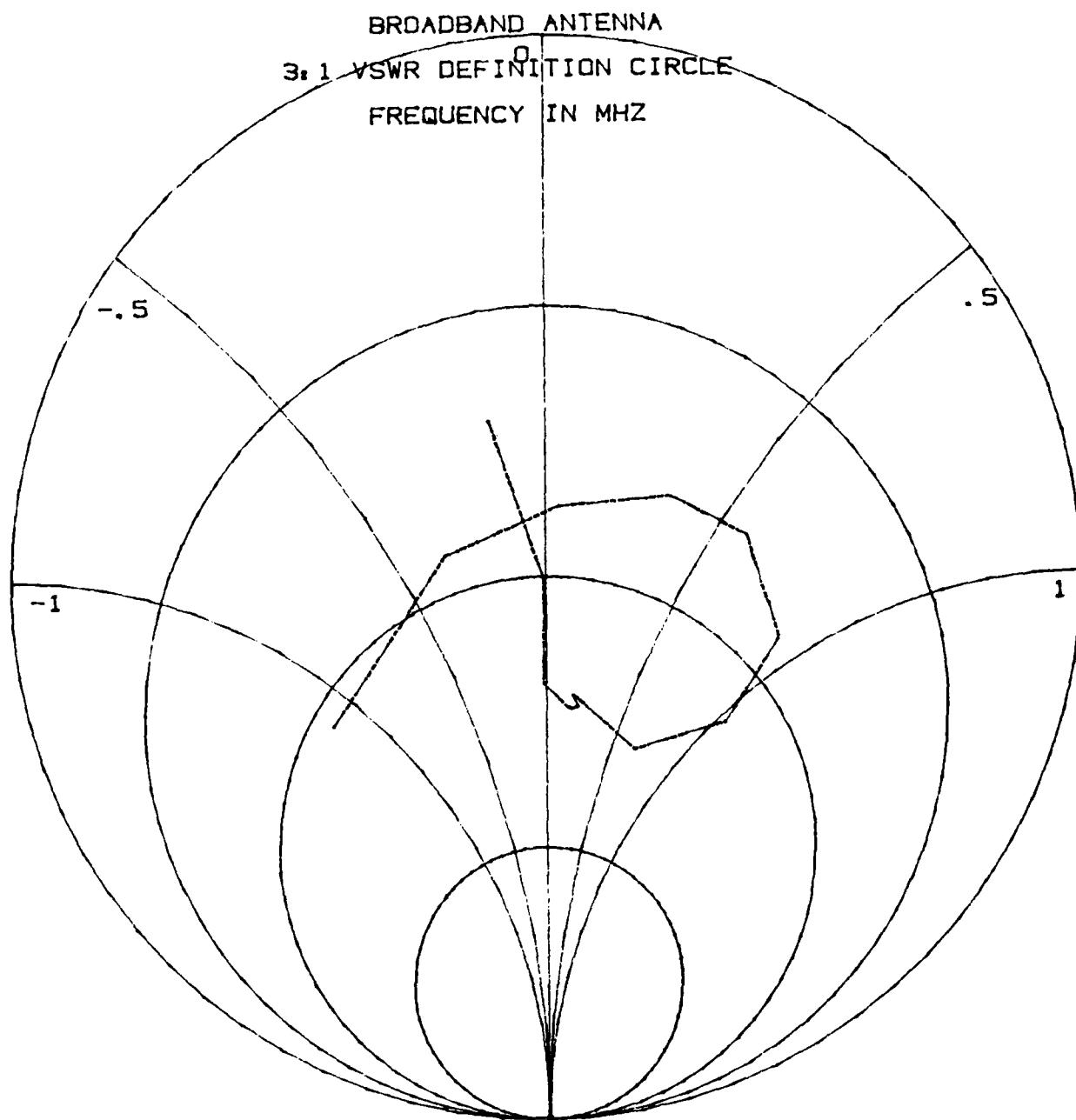
The sample plots in this Appendix were made on an HP plotter for the sample data sets. The following table lists the name of the data set, the title of the sample plot, and the page number on which the plot is reproduced.

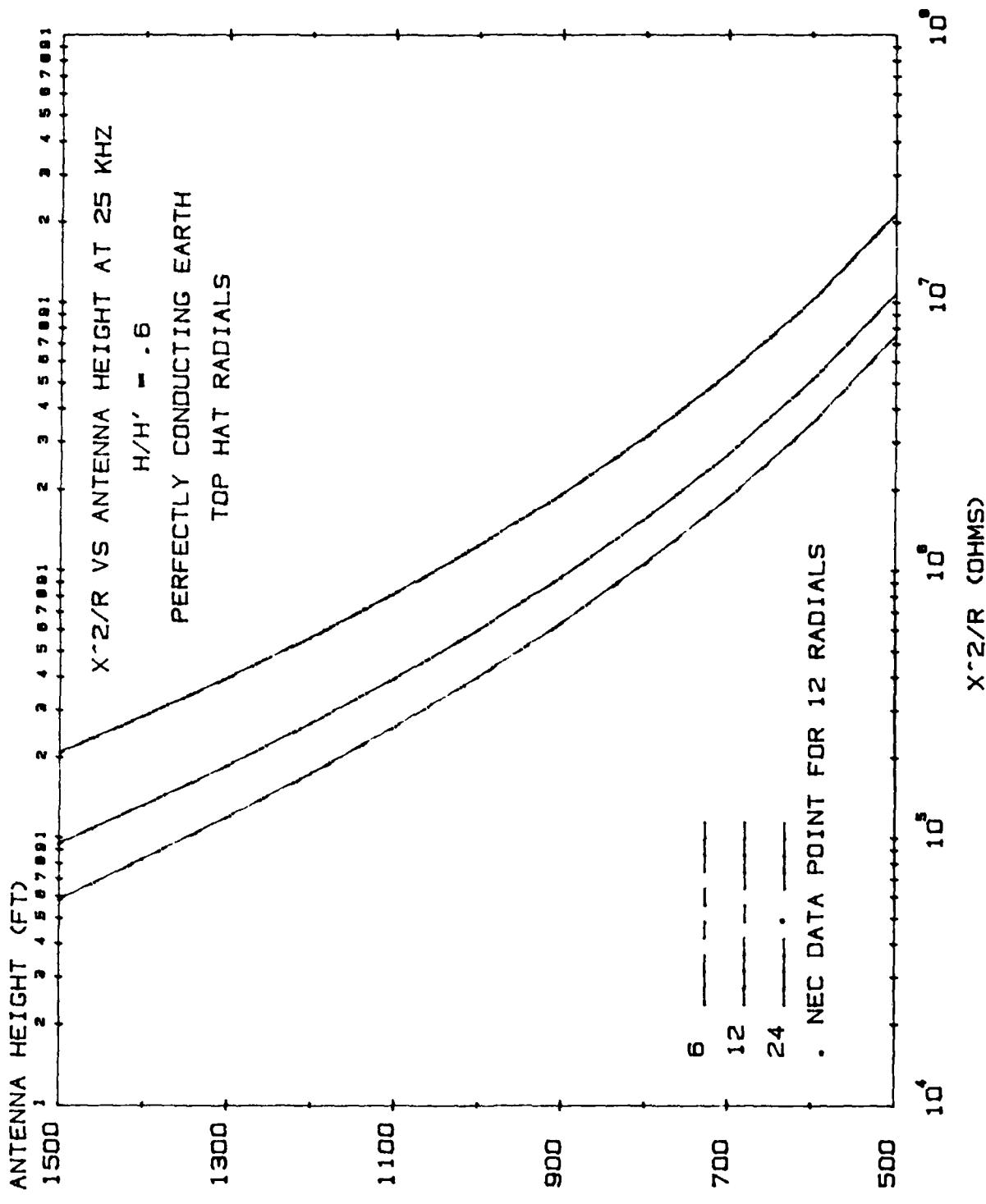
Data Set Name	Plot Title	Page No.
BILIN.DAT	CURRENT AND CHARGE DISTRIBUTION	C-2
LOGLOG.DAT	ADMITTANCE OF A HALF WAVE DIPOLE	C-3
LINEAR.DAT	EFFICIENCY VS. RADIAL LENGTH (ft)	C-4
SMITH.DAT	BROADBAND ANTENNA	C-5
LOGLINH.DAT	X 2/R VS. ANTENNA HEIGHT AT 25 kHz (Note: The log scale is horizontal.)	C-6
LOGLINV.DAT	X 2/R VS. ANTENNA HEIGHT AT 25 kHz (Note: The log scale is vertical.)	C-7
POLAR.DAT	10.67 METER MONOPOLE AT 10 MHz (Note: A 360 degree polar plot.)	C-8
POLARCCW.DAT	10.67 METER MONOPOLE AT 10 MHz (Note: A 90 degree polar plot.)	C-9
CONTOUR.DAT	TWIN YOKED FAN (2-1) PEAK E-FIELD (V/M)	C-10

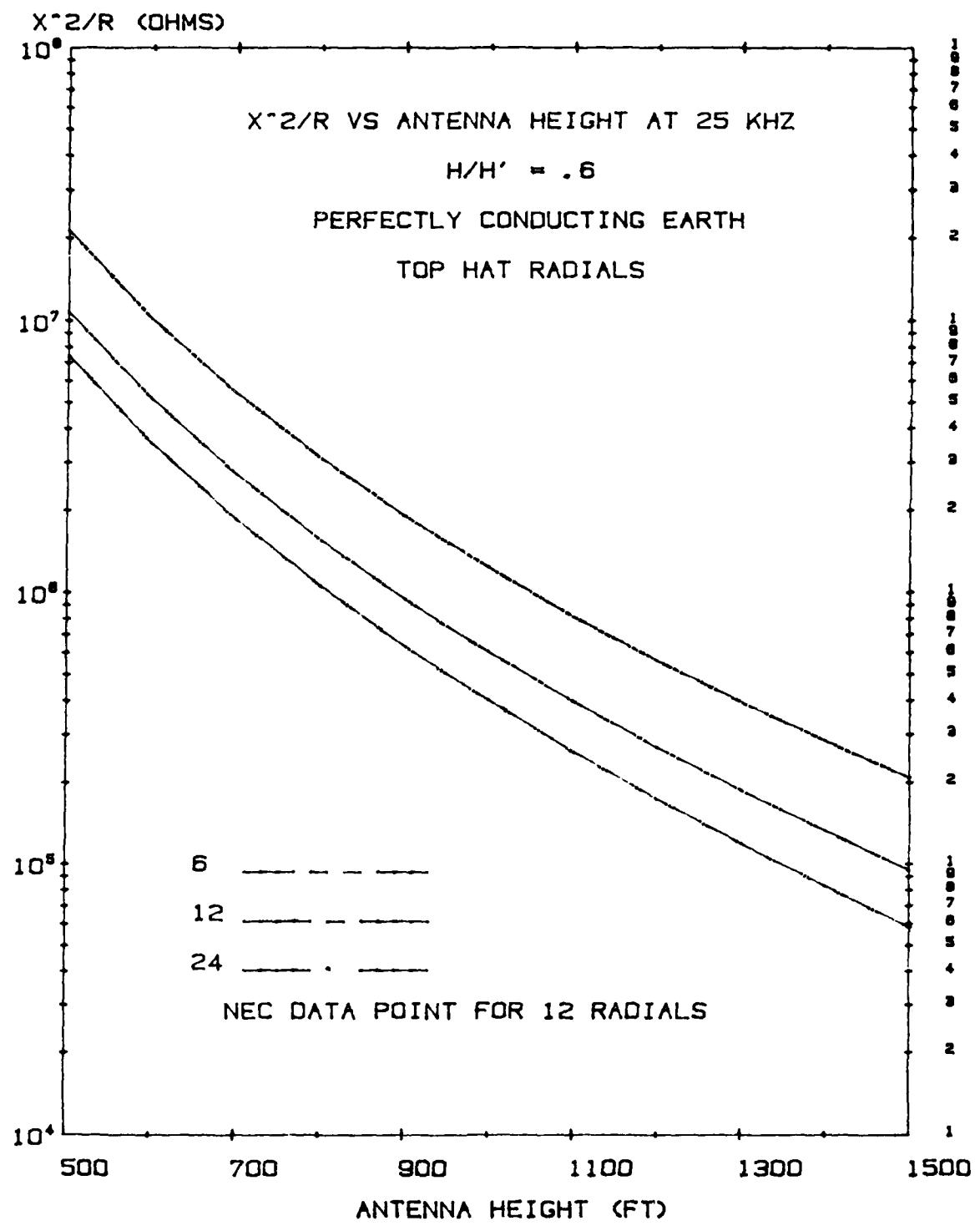






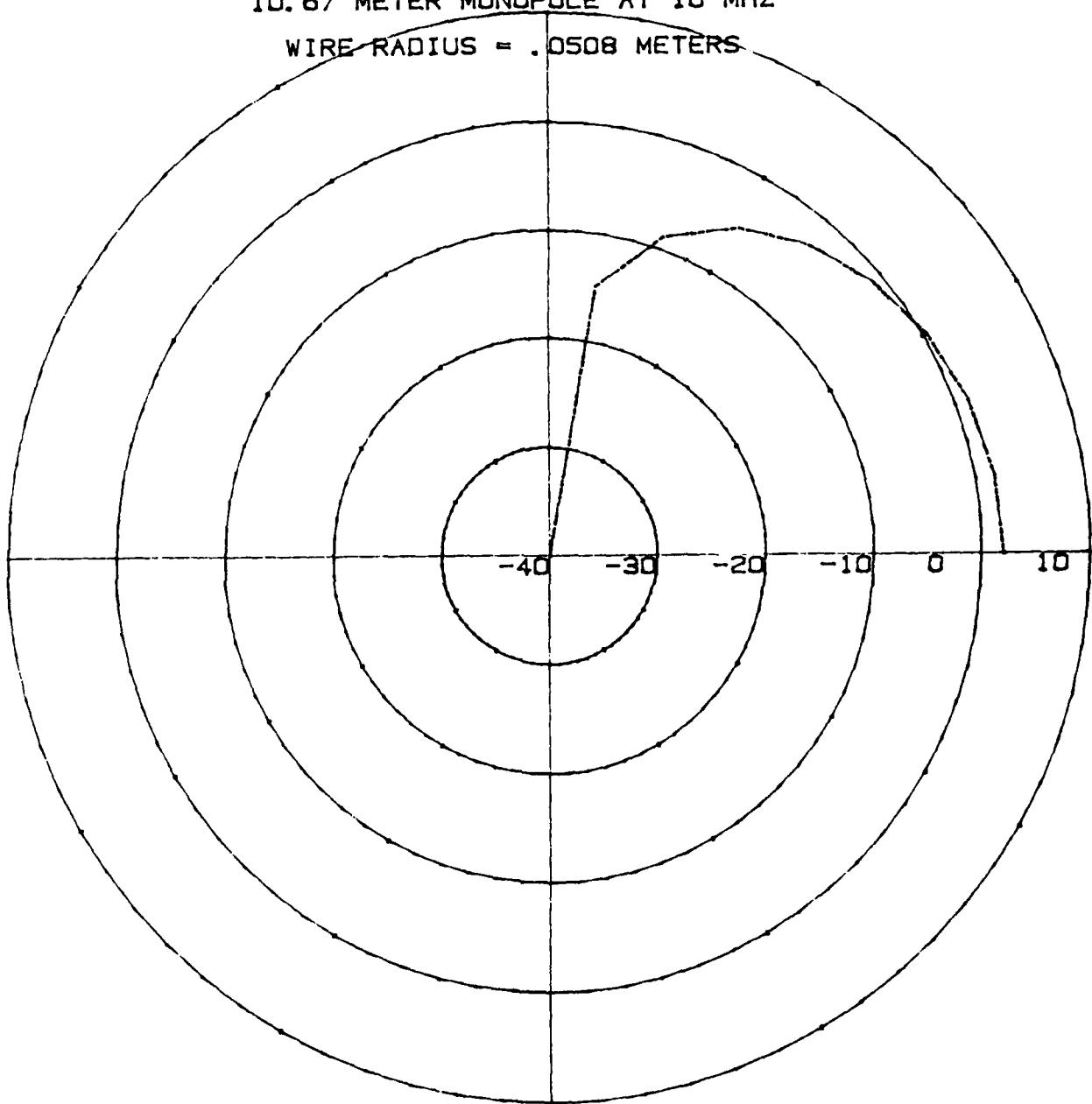


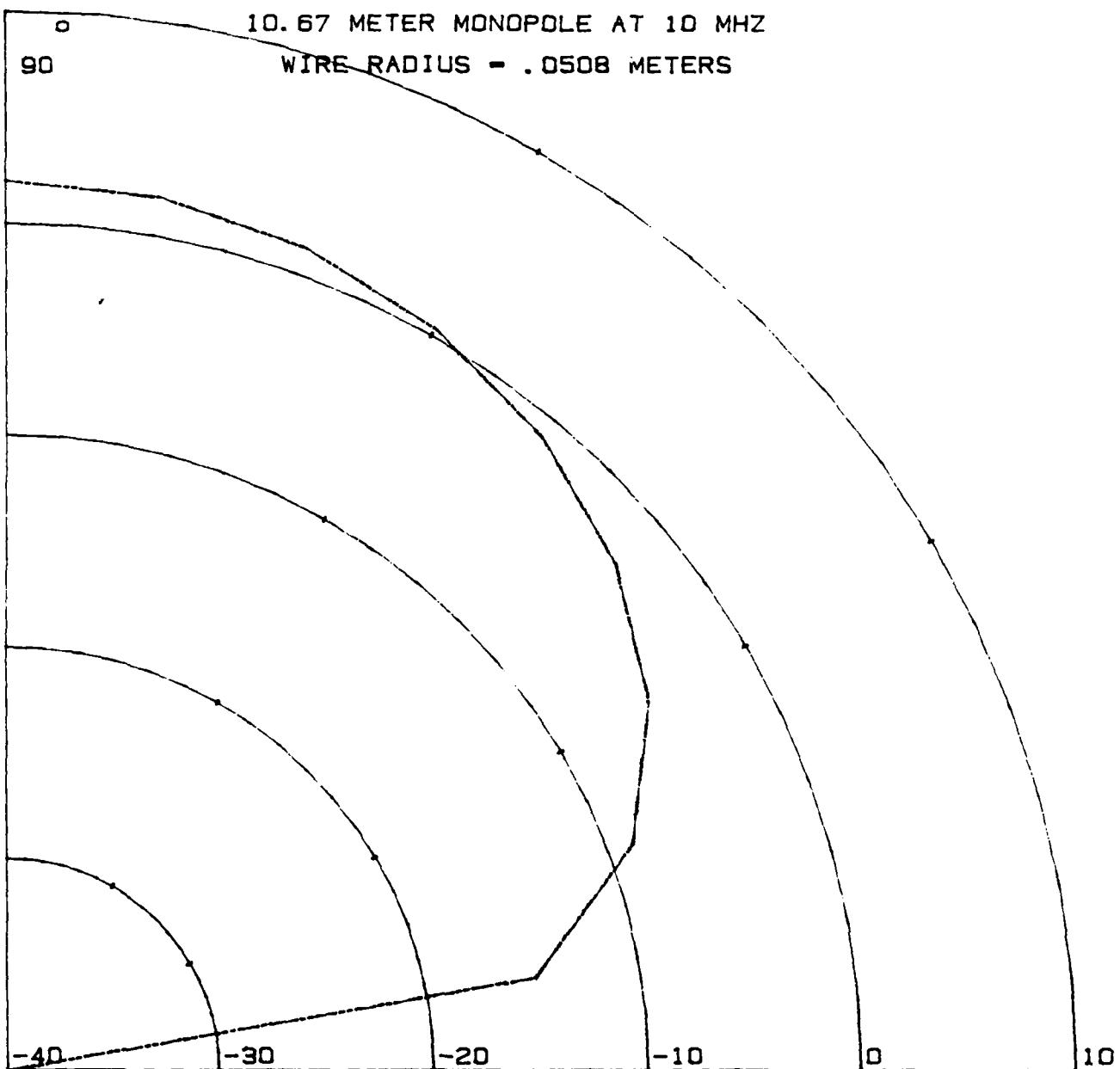




10.67 METER MONPOLE AT 10 MHZ

WIRE RADIUS = .0508 METERS





TWIN YOKED FAN (2-1) PEAK E-FIELD (V/M)

